

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
6 June 2002 (06.06.2002)

PCT

(10) International Publication Number
WO 02/44469 A1

(51) International Patent Classification⁷: D21F 9/00, 7/00

(74) Agent: FORSSÉN & SALOMAA OY; Eerikinkatu 2,
FIN-00100 Helsinki (FI).

(21) International Application Number: PCT/FI01/01040

(22) International Filing Date:
29 November 2001 (29.11.2001)

(25) Filing Language: Finnish

(26) Publication Language: English

(30) Priority Data:
20002628 30 November 2000 (30.11.2000) FI

(71) Applicant (for all designated States except US): METSO
PAPER, INC. [FI/FI]; Fabianinkatu 9 A, FIN-00130
Helsinki (FI).

(72) Inventors; and

(75) Inventors/Applicants (for US only): JUPPI, Kari [FI/FI];
Hiekkapohjantie 259, FIN-40270 Palokka (FI). KOMU-
LAINEN, Antti [FI/FI]; Tarhiantie 22, FIN-42700 Keuruu
(FI).

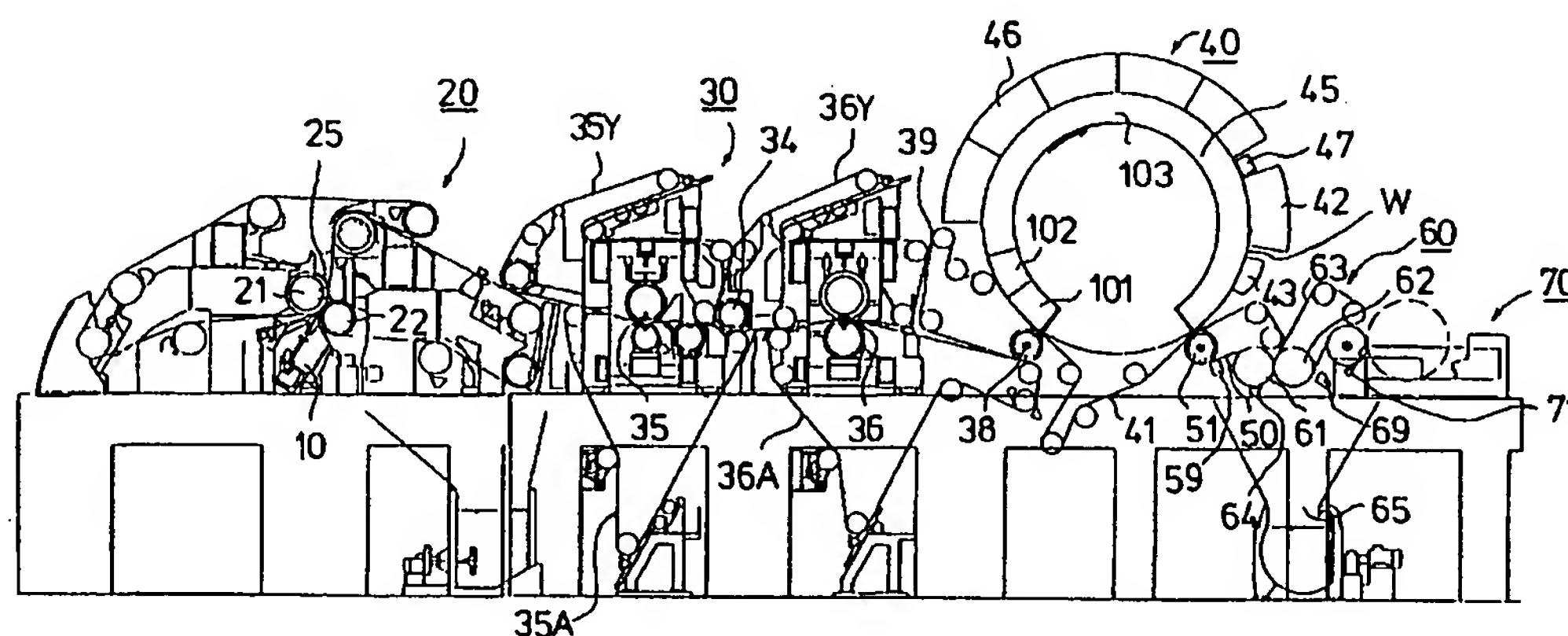
(81) Designated States (*national*): AE, AG, AL, AM, AT, AT
(utility model), AU, AZ, BA, BB, BG, BR, BY, BZ, CA,
CH, CN, CO, CR, CU, CZ, CZ (utility model), DE, DE
(utility model), DK, DK (utility model), DM, DZ, EC, EE,
EE (utility model), ES, FI, FI (utility model), GB, GD, GE,
GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR,
KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK,
MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU,
SD, SE, SG, SI, SK, SK (utility model), SL, TJ, TM, TR,
TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM,
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),
Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),
European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR,
GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent
(BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR,
NE, SN, TD, TG).

Published:
— with international search report

[Continued on next page]

(54) Title: METHOD AND DEVICE IN A PAPER OR BOARD MACHINE



(57) Abstract: The invention relates to a method in a paper or board machine, in which method water is removed from a paper or board web (W) by pressing in a press section (30), in which pressing stage the web (W) is pressed in at least one press nip (35; 36), and in which method the web (W) is dried after pressing by impingement drying, in which method the web (W) is passed as a closed draw from the press section (30) to a dryer section (40), and the method applies full-width threading from the press section (30) to the dryer section (40). The web (W) is dried by impingement drying by means of impingement units (46) placed around at least one large-diameter impingement roll (45). In the method, the web (W) is passed after impingement drying as a closed draw through the dryer section (40) to a calender (60), and in the method threading is accomplished as of full width through the dryer section (40). The invention also relates to a device in a paper or board machine, which device comprises at least one press nip (35, 36) and an impingement roll (45) and impingement drying unit (46) arranged in connection therewith and means (36A, 38, 36Y) for passing a web from a press section (30) onto the impingement drying roll (45) as a closed draw, as well as means for accomplishing threading. Means (50, 51) for passing the web (W) as a closed draw to a calender (60) and means for accomplishing full-width threading through a dryer section are arranged after the impingement roll (45).

WO 02/44469 A1

WO 02/44469 A1



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Method and device in a paper or board machine

5

The invention relates to a method in a paper or board machine according to the preamble of claim 1.

10

The invention also relates to a device in a paper or board machine according to the preamble of claim 12.

15

20

25

As known from the prior art, in multi-cylinder dryers of paper machines, twin-wire draw and/or single-wire draw is/are employed. In twin-wire draw, the groups of drying cylinders comprise two wires which press the web, one from above and the other one from below, against the heated cylinder surfaces. Between the rows of drying cylinders, which are usually horizontal rows, the web has free and unsupported draws which are susceptible to fluttering, which may cause web breaks, in particular as the web is still relatively moist and, therefore, has a low strength. Therefore, in recent years, ever increasing use has been made of said single-wire draw in which each group of drying cylinders comprises only one drying wire on whose support the web runs through the entire group so that the drying wire presses the web against the heated cylinder surfaces of the drying cylinders and the web remains at the side of the outside curve of the reversing cylinders or rolls situated between the drying cylinders. Thus, in single wire draw, the drying cylinders are arranged outside the wire loop, and the reversing cylinders or rolls are arranged inside the loop.

30

With increasing speeds of paper machines, the runnability of a paper machine is, of course, also affected by the dryer section, whose length with the prior art multi-cylinder dryers would, at high speeds, also become very long. If it is imagined that a present-day multi-cylinder dryer were used at a web speed of 40 m/s, it

would include about 40 - 80 drying cylinders, and its length in the machine direction would be about 180 m. In such a case, the dryer would comprise several wire groups and a corresponding number of draws over the group gaps. It is to be assumed that, in a speed range of 30 to 40 m/s, the runnability of the normal prior art multi-cylinder dryers would no longer be even nearly satisfactory, but web breaks would be frequent, which lowers the efficiency of the paper machine. Open draws in particular are problematic, the web moving in them without support of a fabric or a roll or a cylinder or equivalent. To enhance runnability, attempts have been made to find arrangements in which free draws are minimized.

10

In a speed range of 30 - 40 m/s and at higher speeds, the prior art multi-cylinder dryers would also become uneconomical because the cost of investment of an excessively long paper machine hall would be unduly high. It can be estimated that, at present, the cost of a paper machine hall is typically about one million FIM per metre in the machine direction.

15

Thus, the dryer sections of paper machines known today are formed of dozens of drying cylinders and reversing rolls or reversing cylinders associated with them. In a modern high-speed newsprint machine there are in total about 60 - 80 such rolls and cylinders.

20

Moreover, in the applications known from the state of the art, it has been necessary to accomplish threading at least partly by using a lead-in strip, and the strip has been conveyed from one position to another before it is spread to the width of the web, which lowers the production capacity which is achieved.

25

The wet strength and the elastic properties of a paper web depend on the solids content of the web and, directly after the press section, it has been problematic to make the web sufficiently tight because the web has not been sufficiently dry. For this reason, in single-wire draw groups, which are often placed at the beginning of the dryer section, i.e. in so-called slalom-draw groups, problems have been

30

encountered in runnability, in particular in high-speed paper machines. As one solution, short groups including just a few cylinders have been employed at the beginning of the dryer section, so that by means of a positive difference in speed between the groups, it has been possible to maintain web tightness. The solution,
5 however, increases the costs of investment and operation because of the increased number of wire circulations.

When attempting to achieve high speed and good runnability, a web with a high solids content has been needed from the press section and a high difference in
10 draw has been required between the press section and the dryer section, in which connection certain properties of the paper web may, however, be destroyed. A high draw difference can, for example, have an adverse effect on the porosity of the paper web. Since it has been necessary to restrict the temperature of the drying cylinders of the dryer section at the beginning of the dryer section for runnability
15 reasons, it has led to poor operating efficiency. In addition, for runnability reasons, between the press section and the dryer section it has been necessary to use a high draw difference, which also mainly has an adverse effect on the elongation and strength properties of the web, in which connection it has not been possible to control the quality of the paper web in a desired manner as runnability
20 has determined the situation.

Moreover, when tightening of the paper by means of differences in speed between support fabrics has been employed, the paper web may be constricted unevenly, and high differences in tension applied to the web may cause problems in
25 achievement of a sufficiently uniform quality, in particular in relation to the cross-direction profile of the paper.

Since the profile properties must be in order after the press section and in today's paper machines the web must most often be conveyed through the entire paper
30 machine before its properties are measured, the delay becomes very long, with the result that regulation is slow.

Accordingly, it is an object of the present invention to provide novel solutions for the problems mentioned above so that said drawbacks in the prior art and drawbacks that will come out later are substantially avoided.

5

It is an object of the invention to propose a solution that enables full-width threading from the press to the dryer section and through the dryer section.

10

It is known in the prior art to use various impingement/through drying units for evaporation drying of a paper web, which units have been used for drying paper. With respect to the prior art related to this, reference is made, for example, to the documents *FI 931263* (corresponding to *US 5,495,678*) and *SE 9502570*.

15

From the prior art applications are also known in which threading has been accomplished as of full-width from the press to the dryer section. With respect to the prior art relating to these, reference is made to the document *FI 905798* (corresponding to *US 5,389,205*).

20

With a view to achieving the objects described above as well as those which will come out later, the method according to the invention is mainly characterized in that which is stated in the characterizing part of claim 1.

25

In addition, the device in a paper or board machine according to the invention is mainly characterized in that which is stated in the characterizing part of claim 12.

30

In the present invention and in its different embodiments, the inventors have succeeded in combining some partial solutions in a new and inventive manner, some of them prior known in themselves from paper machine technology, such that it has been possible to get the above-mentioned problems, different by nature, under control and solved by a new overall concept.

In accordance with one advantageous exemplifying embodiment, the concept according to the invention comprises a large-diameter impingement roll, an impingement arrangement associated therewith, a measuring beam, a profiling unit, a curl control apparatus located on the impingement roll, a suction roll
5 located after the large impingement roll, and a belt calender located before a reel. After the belt calender, there is also a measuring beam, when needed, two measuring beams can also be used.

In an advantageous embodiment of the invention, the web is transferred from a
10 press section onto the large impingement roll as a supported draw and as of full width. By means of devices located inside a transfer roll, a vacuum is provided through a perforated roll shell to the surface of the roll, and the web is transferred by means of said vacuum onto the surface of a transfer fabric on the surface of the roll. The web is transferred from the transfer fabric onto the fabric of the
15 impingement roll (large vacuum roll) by means of the vacuum of the large vacuum roll. The impingement or vacuum roll represents prior art known in itself as applied in the invention to a larger size. Depending on the application, the roll can thus be of the type known under the applicant's trademark VacRoll, in which the vacuum prevailing inside the roll acts to the same extent over the entire length
20 of the circumference of the roll, and the interior of the roll has not been divided into separate chambers. It is also possible to use a conventional suction roll type, in which connection one or more boxes are arranged in the interior of the roll to divide the roll in the circumferential direction into chambers, sectors, in which vacuums of different magnitude can be used. The diameter of the roll is over 2.5
25 m, even over 10 m, most appropriately 3 – 6 m. There may be one or more impingement drying groups one after the other. In applications in which one large-diameter roll is employed for drying the web substantially dry, the diameter of the roll is typically over 10 m. When several rolls are used in succession, their diameter is typically 3 – 6 m. The web is dried on the large roll by the
30 impingement technique, and a first measuring beam is located after the impingement proper, said measuring beam measuring moisture, basis weight, ash

and the like from one side while the paper is against a wire. After the measuring beam, there is an impingement portion in which the moisture profile of the web is corrected and this is followed by correction of curl by moisturizing. A moisturizing beam is advantageously provided with a housing and a suction blowing in order that moist water mist shall not escape into the surroundings. When the paper has been dried, its moisture profile has been corrected and curl is under control, the next step is to treat the surface of the paper. In the arrangement in accordance with the invention, the web is passed from the wire of the large impingement roll by means of a suction roll to a calender, which is formed by, for example, a smooth heated roll and a belt roll placed against it. The web is brought as of full width to the calender roll, from the doctor of which it can be run down into a pulper. The tail is passed from here to a reel as of full width or as a strip. The device used for cutting the lead-in strip, for instance, a spray cross cutter, is placed, when needed, for example, in connection with a transfer wire.

The arrangement in accordance with the invention provides a fully closed draw all the way to the calender, even through the paper machine, and full-width threading can be accomplished through the dryer section, even as far as the calender and the reel. Since the web is supported from the press section to impingement drying and advantageously further to the calender, the solids content of the paper need not be raised in the press section for runnability, but, instead, it is possible to run the desired solids content. Moreover, quality values can be selected as the determining factors in treatment once runnability problems have been solved.

In addition, control of paper quality is possible thanks to the measurement devices most appropriately placed at various locations.

When the arrangement in accordance with the invention is applied and when a measurement device is advantageously placed in connection with the impingement roll, it is also possible to utilize a web possibly of poor quality

produced in the starting stage, which web can be run and the values can be adjusted to a correct level.

Moreover, when using impingement drying in accordance with the invention,
5 steam is not needed, but impingement is most appropriately accomplished with gas, for example, natural gas.

The invention also allows a draw difference according to the desired quality to be used because runnability is not a decisive factor.

10

When using the arrangement in accordance with the invention, the moisture profile also need not be as precise when coming from the press section as in the prior art arrangements because, when using impingement, the web can be made dry at one go, in which connection no transfers are needed from one cylinder to
15 the next, during which transfer the web having an uneven moisture profile adheres unevenly to the cylinder and causes runnability problems.

In accordance with an advantageous feature of the invention, impingement drying and a calender have been integrated, whereby the resultant length of the paper
20 machine is considerably shorter than that of the prior art dryer sections.

In the following, the invention will be described in more detail with reference to the figures in the appended drawing, to the details of which the invention is, however, not by any means meant to be narrowly confined.

25

Figure 1 is a schematic view of a prior art paper machine.

Figure 2 is a schematic view of an advantageous application of the invention.

30 Figure 3 is a schematic view of a second advantageous application of the invention, in which, as compared with the one shown in Fig. 2, the draw between

a calender and a reel is closed and a support fabric does not run through the nip of the calender.

5 Figure 4 is a schematic view of another advantageous application of the invention, in which, as compared with the application shown in Fig. 2, the draw of the web from a press to a dryer section is different.

10 Figure 5 is a schematic view of an application of the invention which mainly corresponds to the one shown in Fig. 2 but a multi-nip calender is used as the calender.

Figure 6 is a schematic view of an application of the invention in which a paper web is surface-sized, after-dried, calendered and reeled after a dryer section.

15 Figure 7 is a schematic view of an application of the invention in which several impingement units are used and the web is passed from impingement drying through a multi-nip calender to a reel.

20 Figure 8 is a schematic view of an application of the invention which mainly corresponds to the application shown in Fig. 7 but the draw from the calender to the reel is closed.

25 Figure 9 is a schematic view of an application of the invention which mainly corresponds to the application shown in Fig. 6 but the draw from one drying unit to the next is closed.

30 Fig. 1 schematically shows one prior art application in which stock is fed from a headbox 100 to a wire section 200, in which a gap former 250 is located and which is followed by a press section 300 having two press nips 350. A web W is passed from the press section 300 to a dryer section 400 to a first drying group 410, which is arranged to be a so-called short group for runnability reasons, and

which is followed by single-wire draw groups 450 in the application shown in the figure. The web W is passed via a measuring beam 500 to be surface-sized on a sizer 600, after which the web W is dried in an after-dryer section 700 in single-wire draw groups 750. After that, the web W is calendered in a calender 800 and,
5 finally, the web W is passed to a reel 900, in which the web is reeled into rolls 950.

Some advantageous exemplifying embodiments of the invention are illustrated in Figs. 2-8, and the same reference signs have been used of the corresponding parts,
10 and the applications shown in them correspond to one another unless otherwise stated.

As shown in Fig. 2, the basic concept of the invention comprises a large-diameter impingement roll 45, impingement units 46 associated therewith, and a measuring
15 beam 47, a profiling unit 42 and a curl control apparatus 43 placed on the impingement roll 45, a suction roll 51 placed after the large impingement roll 45, and a belt calender 60 placed before a reel 70. After the belt calender 60 there is also a measuring beam 69.

20 As shown in Fig. 2, a web W is passed from a press section 30 onto the large impingement roll 45 as a supported draw and as of full width. On the large roll 45, the web W is dried by the impingement technique by means of the impingement units 46, and the measuring beam 47 is located after the impingement proper, said measuring beam measuring moisture, basis weight, ash, etc. from one side while
25 the paper W is against a wire 41. The measuring beam 47 is followed by the profiling unit, for example, an impingement device 42 or a steam box or equivalent, by means of which the moisture profile of the web W is corrected. After that, there is curl correction by moisturizing with the curl control apparatus 43, for example, a moisturizing beam with a housing and air blowing (not shown)
30 closely connected therewith in order that moist water mist shall not escape into the surroundings. As shown in the figure, after the impingement roll 45 there is a

transfer wire 50 on which the web W is passed to a first roll 61 of the calender 60, a belt roll 62 constituting the backup roll of the first roll 61 and having its own belt loop 63. After that, the web W is passed further as a closed draw to the reel 70.

5

When the paper has been dried, the moisture profile has been corrected and curl is under control, surface treatment of the paper is carried out. In accordance with the invention, the web W is passed from the wire 41 of the large impingement roll 45 by means of a suction roll 51 and the transfer fabric 50 to the calender 60, which, in the application shown in Fig. 2, is formed by the smooth heated roll 61 and the belt roll 62 placed against it. The web is brought as of full width to the heatable calender roll 61, from whose doctor 64 it can be run, when needed, down into a pulper 65. From here, the web is passed to the reel 70 as of full width or as a strip. A doctor 71 is arranged in connection with a reel drum of the reel 70.

15

In the application of the invention shown in Fig. 2, a fully closed draw has been provided through the paper machine and full-width threading can be accomplished all the way to the calender 60 and as far as the reel 70. In addition, the quality of paper is controlled in each treatment phase. In connection with the transfer fabric 50, it is possible to arrange, when needed, a diagonal cutter apparatus 59 for cutting a lead-in strip.

20

In the paper machine in accordance with one application of the invention shown in Fig. 2, the run of the paper web W is as follows. Stock is supplied from a headbox 10 into a gap between forming rolls 21, 22 of a gap former 25 in a wire section 20, from which gap it is passed between wires past dewatering devices of the gap former 25 further on support of a wire to a press section 30. The press section 30 comprises two presses 35 and 36, and the web W is passed on an upper fabric of the first press 35 between the press rolls of the press 35 while supported by a lower fabric. From the lower fabric the web W is passed onto an upper fabric of the next press 36 and further between the upper fabric and a lower fabric

25

30

between the press rolls of the press 36. From the press section 30 the web W is passed from the lower fabric of the latter press 36 on a transfer fabric 39 and via a transfer suction roll 38 arranged in connection therewith as a supported draw without a free draw to the dryer section 40 onto the drying wire 41, on whose support the web W is passed onto the large-diameter impingement drying cylinder 45. The impingement units 46 are arranged in connection with the impingement drying cylinder 45.

In the exemplifying embodiment shown in Fig. 2, the transfer fabric 39 is arranged before the impingement roll above the lower fabric 36A of the last press nip 36 of the press section 30, the web W being detached from the fabric 36A of the press and transferred onto the surface of the transfer fabric 39 by means of the transfer suction roll 38 arranged in connection with the transfer fabric 39. From the transfer fabric the web W is transferred by means of the vacuum of the impingement roll 45 onto the wire 41 and further so as to run around the impingement roll 45, which is a large-diameter vacuum roll provided with devices for producing a vacuum to the surface of the roll 45.

Fig. 2 shows a large vacuum roll which is provided with several boxes 101, 102, 103 for using vacuums of different magnitude over the length of the circumference. The first box 101 is typically a high vacuum zone which serves to eliminate the detrimental effects of the air carried into the closing nip on the surface of the roll and the fabric and to detach the web W efficiently from the surface of the transfer fabric 39 onto the fabric 41. The vacuum of the second box 102 assures that the web adheres to the surface of the fabric 41 in the area where the fabrics 39 and 41 are separated. The third box 103, in which vacuum is typically lower than that of the preceding boxes, keeps the web W on the surface of the fabric 41 while the web runs around the large roll 45. There is no vacuum acting on the circumference of the roll 45 between the transfer suction roll 51 and the first box 101. The zone 101 typically begins before the point where the fabric 39 and the wire 41 running on the roll 45 meet and ends slightly after this point of

meeting. The zone 102 ends when the fabric 39 is substantially separated from the vicinity of the wire 41 and, at the same time, from the vicinity of the roll 45 most appropriately while guided by a wire guide roll, and the zone 103 ends roughly at the point where the wire 41 is detached from the roll 45.

5

The exemplifying embodiment shown in Fig. 3 mainly corresponds to the exemplifying embodiment of the invention shown in Fig. 2. In the exemplifying embodiment of the invention shown in Fig. 2, the draw between the calender 60 and the reel 70 is arranged to be closed by means of a support fabric 63, but differing from the application shown in Fig. 2, the support fabric 63 does not run through the calendering nip formed by calender rolls 61,62, in which connection the calendering nip may be a hard nip or a soft nip. In this application, a measurement device 69 is arranged above the support fabric 63. Fig. 3 shows an application in which there are no separate chambers inside the large roll but the same vacuum prevails over the entire length of the circumference of the roll in accordance with the principle of the roll marketed by the applicant under the trademark VacRoll.

In the exemplifying embodiment shown in Fig. 4, the web W is kept on the upper fabric 36Y of the last press nip 36 by means of a transfer suction roll 31. Vacuum boxes 37 and a suction roll 38N are placed in connection with the fabric 36Y to keep the web W in contact therewith. The web W is transferred from the fabric 36Y onto the impingement roll 45 in the same manner as from the transfer fabric 39 in the applications shown in Figs. 2 and 3.

25

In the exemplifying embodiment shown in Fig. 4, the paper web W is passed to the last press nip 36 of the press section 30 on support of the lower fabric 35A of the press nip 35, from which fabric the web W is transferred by means of a transfer suction roll 34 onto support of the upper press fabric 36Y of the latter press nip 36, the paper web W being passed to the latter press nip 36 while guided by said upper press fabric to remove water from the web W in said nip. The web

30

W is passed from the lower fabric 36A of the latter nip 36 onto the upper fabric 36Y by means of the transfer suction roll 31 and, as a closed draw, onto the drying wire 41 of the impingement drying cylinder 45 of the dryer section 40. The web W is kept on the upper fabric 36Y by means of the vacuum boxes 37 and the suction roll 38N, and from this fabric 36Y the web W is passed further onto the drying wire 41.

As shown in Fig. 4, the paper web W is thus passed from the last press nip 36 of the press section as a fully closed draw by means of the upper fabric 36Y onto the drying wire 41 of the dryer section, after which the paper web W is passed on the transfer fabric 50 to the calender 60.

In Fig. 5, the transfer of the web from the press section 30 to the impingement roll 45 takes place as shown in Fig. 2 and, in the exemplifying embodiment shown in Fig. 5, the web W is passed after the impingement roll 45 from the drying wire 41 as a closed draw on a transfer fabric 50 to the top roll of a multi-nip calender 60 and further through the calender 60 to its bottom roll, in connection with which a doctor 67 is arranged. It is possible to run the web/lead-in strip from the bottom roll of the calender 60 down into a pulper from the doctor 67 placed on the bottom roll. In the application of the invention shown in Fig. 5, the draw between the calender 60 and the reel 70 is open and there is on the web W, for example, a device 77 of the airborne type supporting the run of the web W. A doctor 71 is arranged in connection with the reel drum of the reel 70.

In the exemplifying embodiment shown in Fig. 6, the web W is passed after the first impingement roll 45 over the transfer suction roll 51 onto the transfer fabric 50 and from this as a free draw to a sizing/coating unit 80, in which the web W is surface-sized/coated by means of applicator beams 93A, 93B, and after that forwards as a free draw, and the web W is passed on a suction roll 81 and on its transfer fabric 82 to a second impingement drying roll 45', after which the web W is calendered on the calender 60 and passed to the reel 70, as in Figs. 2 and 4. In

the exemplifying embodiment of Fig. 6, the reference numerals used in the numbering of the latter impingement drying unit correspond to the reference numerals of the first impingement drying unit and the transfer fabric unit arranged in connection therewith, and the reference numerals of the latter unit are provided with an apostrophe for the sake of clarity. In the application shown in Fig. 6, the web W is surface-sized/coated on the sizing/coating unit 80, which is followed by the drying formed by the impingement roll 45' and impingement units 46' and including a drying wire 41'. In addition, a turning device 84 is placed after the coating station 80. Finally, the web W is passed to the calender 60. After the calender 60, the web W is passed to the reel 70, in which the paper web W is reeled into paper rolls.

In the exemplifying embodiment of the invention shown in Figs. 7 and 8 there is a closed draw all the way to the calender 60. In the applications shown in the figures, the web W is passed from the lower fabric 36A of the latter press nip 36 of the press section 30 as a closed draw all the way to the calender 60. The exemplifying embodiment shown in Fig. 7 comprises a dryer section 40 which is formed of four impingement drying units, of which the last one corresponds to the impingement drying unit shown in the previous figures also in respect of additional equipment. The first three impingement drying units comprise a large-diameter impingement drying roll 45, as well as impingement hoods 46 and a drying wire 41 as well as alignment and guide rolls for the drying wire, arranged in connection therewith. The first and the third impingement drying unit is arranged to be a so-called inverted impingement drying group and the second impingement drying unit is situated in the normal direction, and the web W meanders from a lower unit to an upper unit and further back to a lower unit. In the application shown in Fig. 7, the transfer from the impingement drying to the reel 70 corresponds to that described in connection with Fig. 5.

Fig. 8 also shows a multi-nip calender 60, in which the draw between the calender 60 and the reel 70 is closed, so that in this application it is not possible to run the

web down from the calender but it can be done either from the reel drum having a doctor 71 placed in connection therewith or from an auxiliary roll placed before the calender. This exemplifying embodiment shown in Fig. 8 can be combined, for example, with the applications shown in Figs. 2 and 3, thereby providing an arrangement in which the web can also be doctored from the lowermost or the second lowermost roll of the calender into the pulper 65.

The application shown in Fig. 9 mainly corresponds to the one shown in Fig. 6 but the transfer from one drying unit to the other is closed. In the application shown in Fig. 9, the transfer from the dryer section 40 through the sizing/coating unit 80 to the calender 60 is closed, and full-width threading is also possible in it. The web W is passed from the transfer fabric 50 through a closed nip 92, which uses not a high load but a light load, and here the web is transferred from the transfer wire 50 onto a belt 95. The rolls of the nip may be normal wire guide rolls or they may be specially designed in their structure to withstand the special demands placed by nip operation. The transfer fabric 95 is most appropriately a belt which is impervious to air, gas and liquid and which runs through the nip of the sizing/coating unit 80. The web is transferred from the transfer belt 95 by means of a transfer suction roll 97 onto a permeable transfer fabric 82. In this application, one size applicator beam 93A has been moved into connection with the belt 95 before the transfer nip 92 and a size/coating is applied there to the surface of the belt to form a suitable film. The web is passed from a suction roll 96 onto the drying wire 41' of an after-dryer unit 40'.

In the applications shown in the figures in which one large-diameter roll is used in impingement drying to dry the web substantially dry, the diameter of the roll is typically over 10 m. In the applications in which several impingement drying groups are used in succession, the diameter of the large-diameter roll is typically 3 – 6 m. The large-diameter roll can comprise sectors acting by vacuums of different magnitude, and there may be two or more such sectors, or the same vacuum can act on the circumference of the roll over the entire length of the

circumference. Of course, the roll type in the different embodiments of the invention can differ from the examples shown in the figures.

5 Above, the invention has been described only with reference to some of its advantageous exemplifying embodiments, to the details of which the invention is, however, not by any means meant to be narrowly confined.

Claims

1. A method in a paper or board machine, in which method water is removed from a paper or board web (W) by pressing in a press section (30), in which pressing stage the web (W) is pressed in at least one press nip (35; 36), and in which method the web (W) is dried after pressing by impingement drying, in which method the web (W) is passed as a closed draw from the press section (30) to a dryer section (40), and the method applies full-width threading from the press section (30) to the dryer section (40), **characterized** in that the web (W) is dried by impingement drying by means of impingement units (46) placed around at least one large-diameter impingement roll (45), that in the method the web (W) is passed after impingement drying as a closed draw through the dryer section (40; 40') to a calender (60), and that in the method threading is accomplished as of full width through the dryer section (40; 40').
2. A method according to claim 1, **characterized** in that, in the method, threading is accomplished as of full width from the press section (30) to the dryer section (40) and through the dryer section (40; 40') and further to the calender (60).
3. A method according to claim 2, **characterized** in that, in the method, the threading of the web (W) is accomplished as of full width to a reel (70).
4. A method according to claim 1, **characterized** in that, in the method, the web (W) is passed as a closed draw to the reel (70).
5. A method according to claim 1, **characterized** in that, in the method, the web (W) is dried on the impingement roll (45) by means of the impingement units (46) arranged in connection therewith, the properties of the web (W) are measured by means of a measuring beam (47) arranged in connection with the impingement roll (45), the moisture profile of the web (W) is profiled by

means of a profiling unit (42) arranged in connection with the impingement roll (45), the curl of the web (W) is controlled by means of a curl control device (43) arranged in connection with the impingement roll (45), and after that the web (W) is transferred on a transfer suction roll (51) to the calender (60) by means of a transfer fabric (50) as a substantially closed draw.

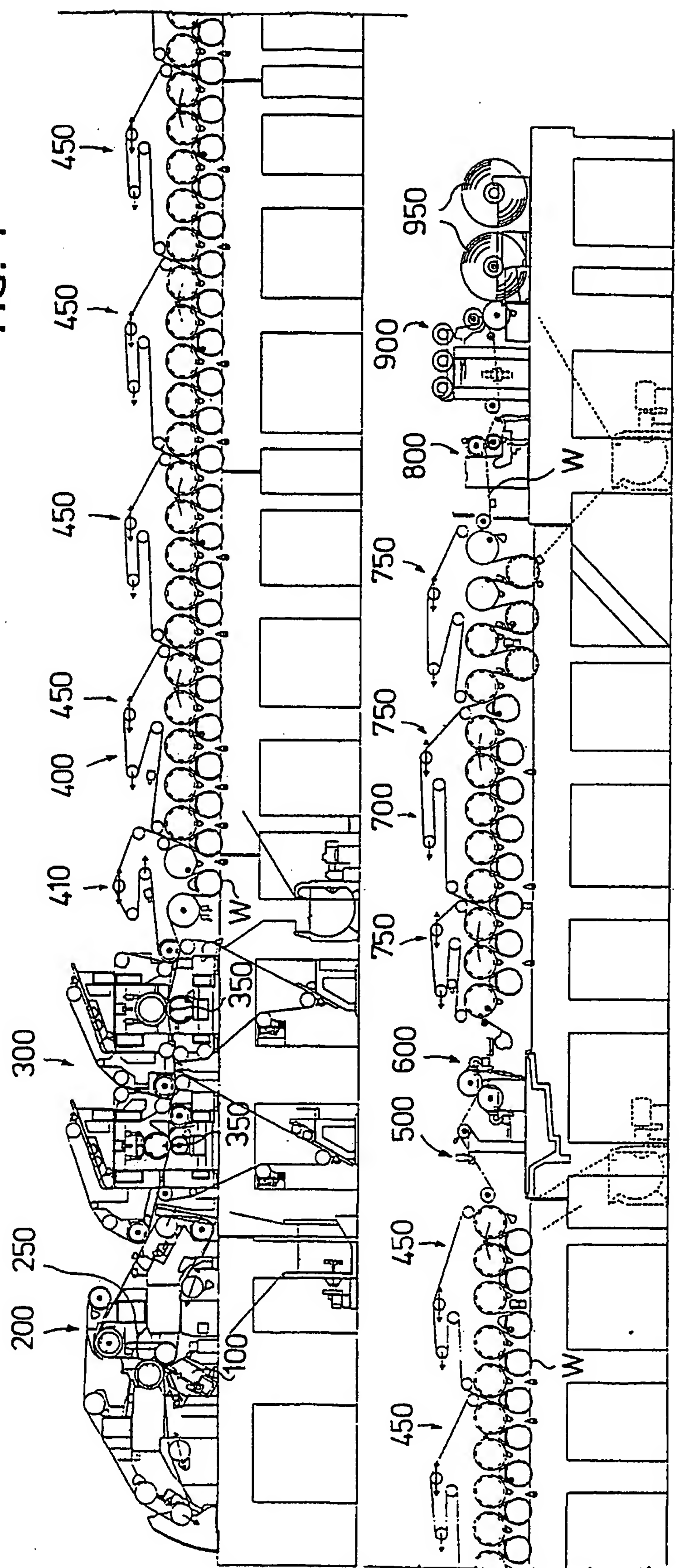
6. A method according to claim 1 or 2, characterized in that the web (W) is calendered in a belt calender (FIG. 2, 4, 6).
7. A method according to claim 1 or 2, characterized in that the web (W) is calendered in a multi-nip calender (FIG. 5, 7, 8).
8. A method according to claim 1 or 2, characterized in that the web (W) is calendered in a single-nip calender (FIG. 3).
9. A method according to claim 1, characterized in that the web (W) is dried on the impingement roll (45) by means of the impingement units (46), the web (W) is passed from impingement drying to a sizing/coating unit (80), after which the web (W) is transferred on a transfer fabric (82) to impingement drying onto a large-diameter roll (45') having impingement units (46') arranged in connection therewith, and that the web (W) is passed to the calender (60) by means of a transfer fabric (50), and that the web (W) is reeled on a reel (70).
10. A method according to any one of claims 1 to 9, characterized in that, in the method, the web (W) is passed from the press (30) to impingement drying on the surface of a fabric (36A; 36Y) of the last press nip (36) of the press, and that the web is detached from the fabric by means of a transfer suction roll (38), the web being transferred on a transfer fabric (39) arranged in connection with said transfer suction roll onto a drying wire (41) of the large-diameter impingement roll (45) used in impingement drying.

11. A method according to any one of claims 1 to 9, **characterized** in that, in the method, the web (W) is transferred from a press fabric (36A, 36Y) onto a drying wire (41) of the large-diameter impingement roll (45) used in impingement drying.
12. A device in a paper or board machine, which device comprises at least one press nip (35, 36) and an impingement roll (45) and impingement drying units (46) arranged in connection therewith and means (36A, 38, 31, 36Y) for passing a web from a press section (30) onto the impingement drying roll (45) as a closed draw, as well as means for accomplishing threading, **characterized** in that means (50, 51) for passing the web (W) as a closed draw to a calender (60) and means for accomplishing full-width threading through a dryer section are arranged after the impingement roll (45).
13. A device according to claim 12, **characterized** in that the device comprises a measuring beam (47), a profiling unit (42) and/or a curl control device (43) arranged in connection with the impingement roll (45).
14. A device according to claim 12 or 13, **characterized** in that the calender (60) is a belt calender.
15. A device according to claim 12 or 13, **characterized** in that the calender (60) is a shoe calender.
16. A device according to claim 12 or 13, **characterized** in that the calender (60) is a multi-nip calender.
17. A device according to claim 12 or 13, **characterized** in that the calender (60) is a single-nip calender.

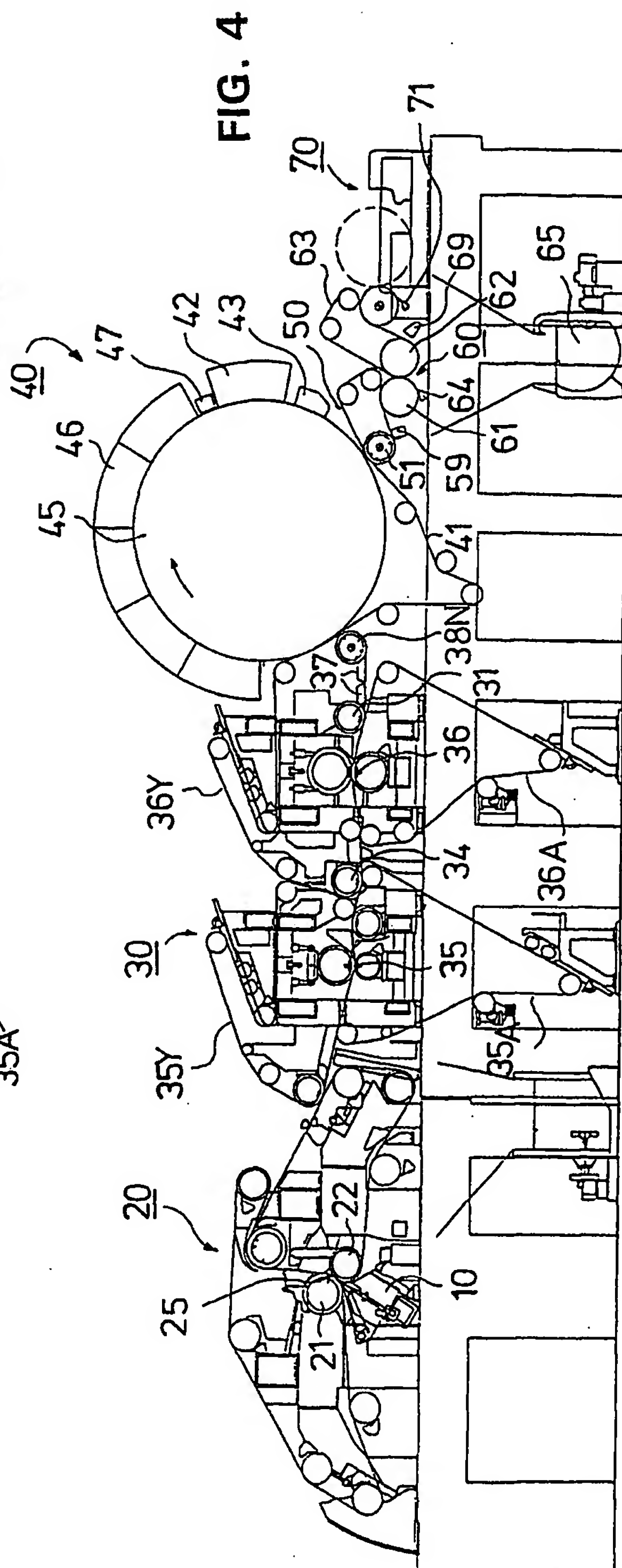
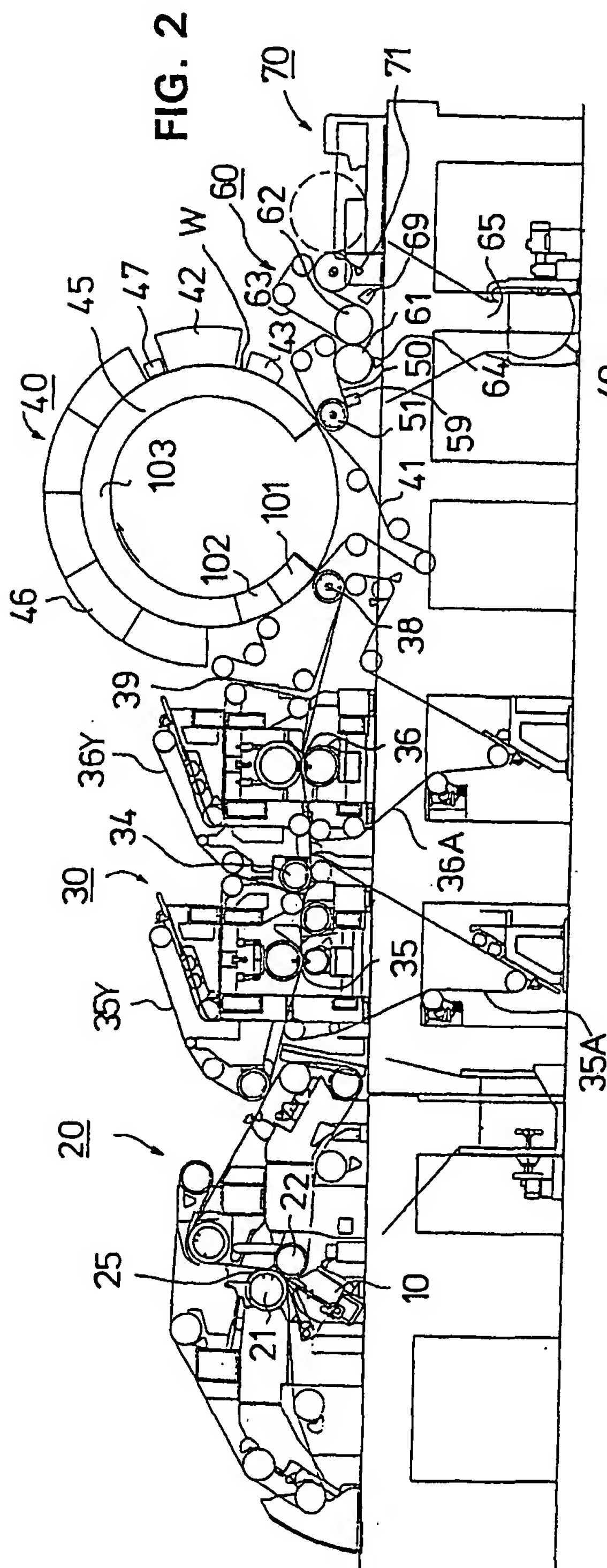
18. A device according to claim 12, **characterized** in that the device comprises a sizing/coating unit (80) which is placed between two large-diameter impingement rolls (45, 45') and that means (51, 50) for passing the web (W) as a closed draw to the calender (60) are placed after the latter impingement roll (45').
19. A device according to claim 12, **characterized** in that the device comprises a reel (70) to which the web can be passed as a closed draw by means of a transfer fabric (63) arranged around a belt roll (62) of the calender (60).
20. A device according to claim 12 or 13, **characterized** in that a transfer fabric (39) is arranged between the press section (30) and the dryer section (40) based on impingement drying, a transfer suction roll (38) being provided in connection with said transfer fabric for passing the web from the press section (30) to the dryer section (40).
21. A device according to claim 12 or 13, **characterized** in that the web (W) is arranged to be passed from the press section (30) to the dryer section (40) based on impingement drying by means of a press fabric running through a press nip (36) of the press.
22. A device according to claim 12 or 13, **characterized** in that the device comprises a transfer fabric (50) for passing the web (W) from the dryer section (40; 40') based on impingement drying to the calender (60).
23. A device according to claim 22, **characterized** in that a measuring device (59, 59') is arranged in connection with the transfer fabric for measuring the properties of the web (W).

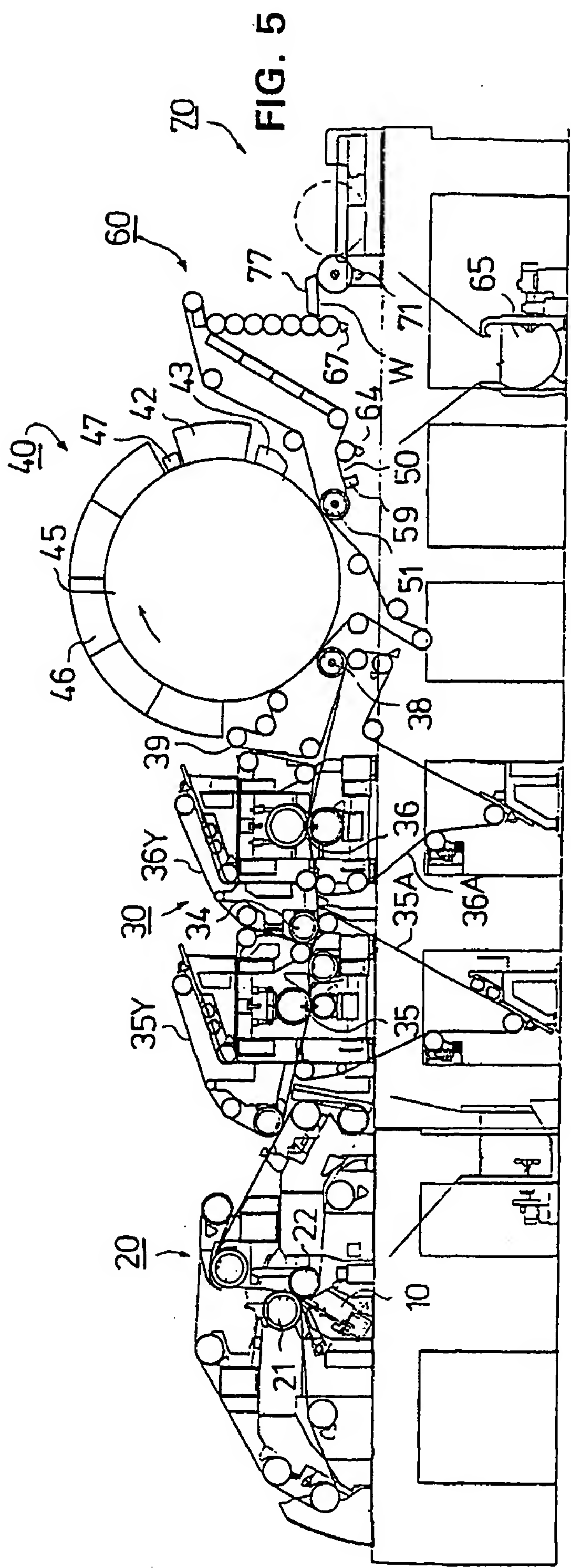
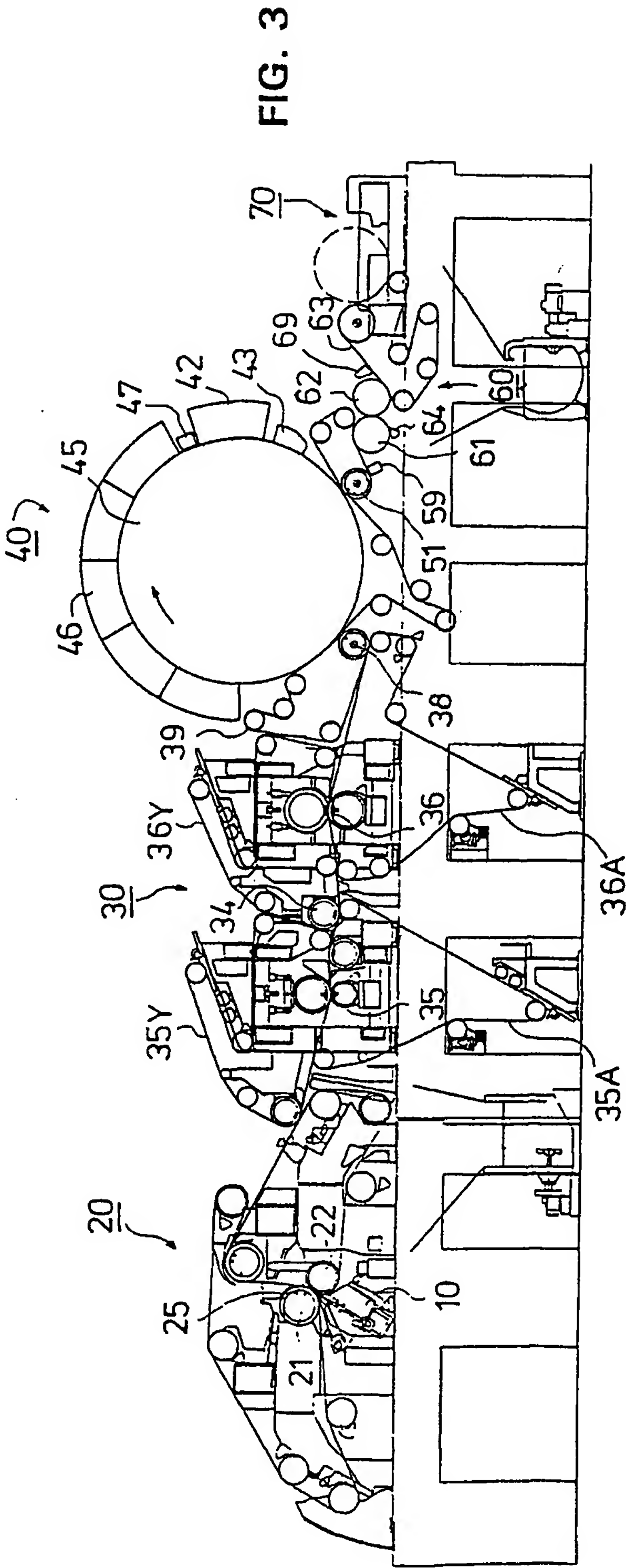
24. A device according to claim 12 or 13, **characterized** in that the device further comprises a transfer fabric (63) for passing the web from the calender (60) to a reel (70).
- 5 25. A device according to claim 12 or 13, **characterized** in that the device comprises vacuum boxes (37) for keeping the web in contact with a transfer fabric (39).
- 10 26. A device according to claim 12 or 13, **characterized** in that, in the device, the draw from the calender (60) to a reel (70) is closed.

FIG. 1



PRIOR ART





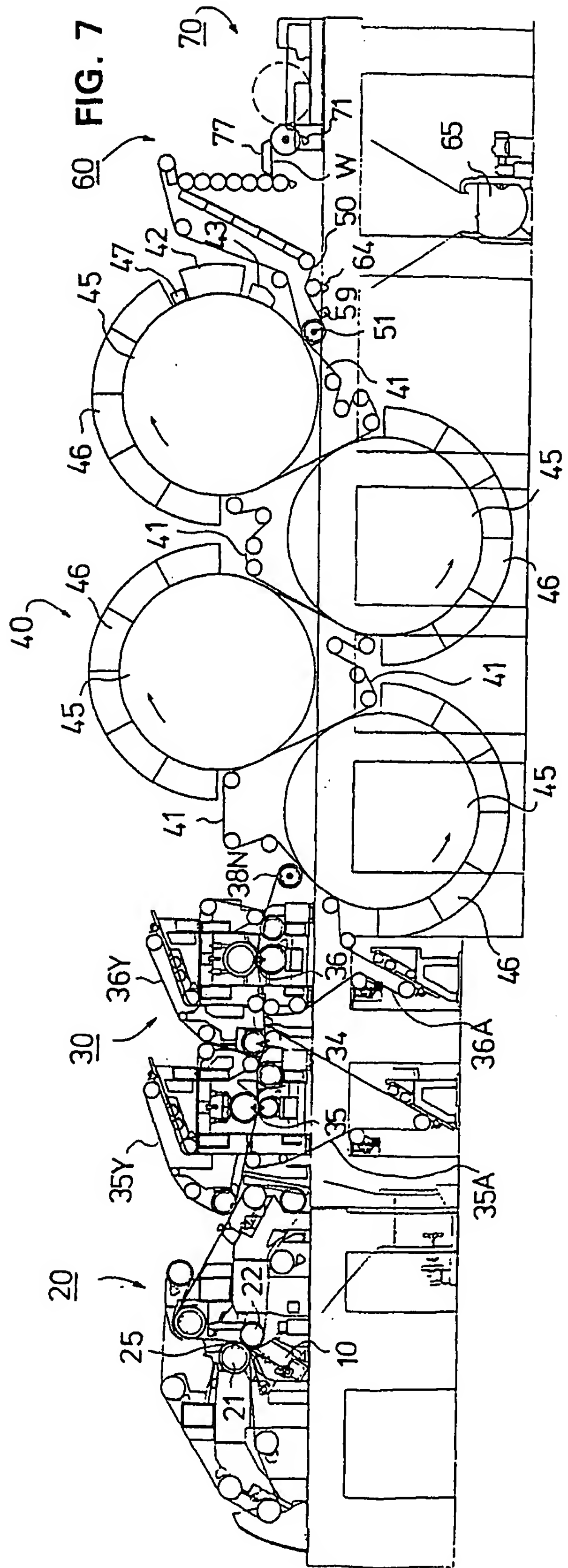
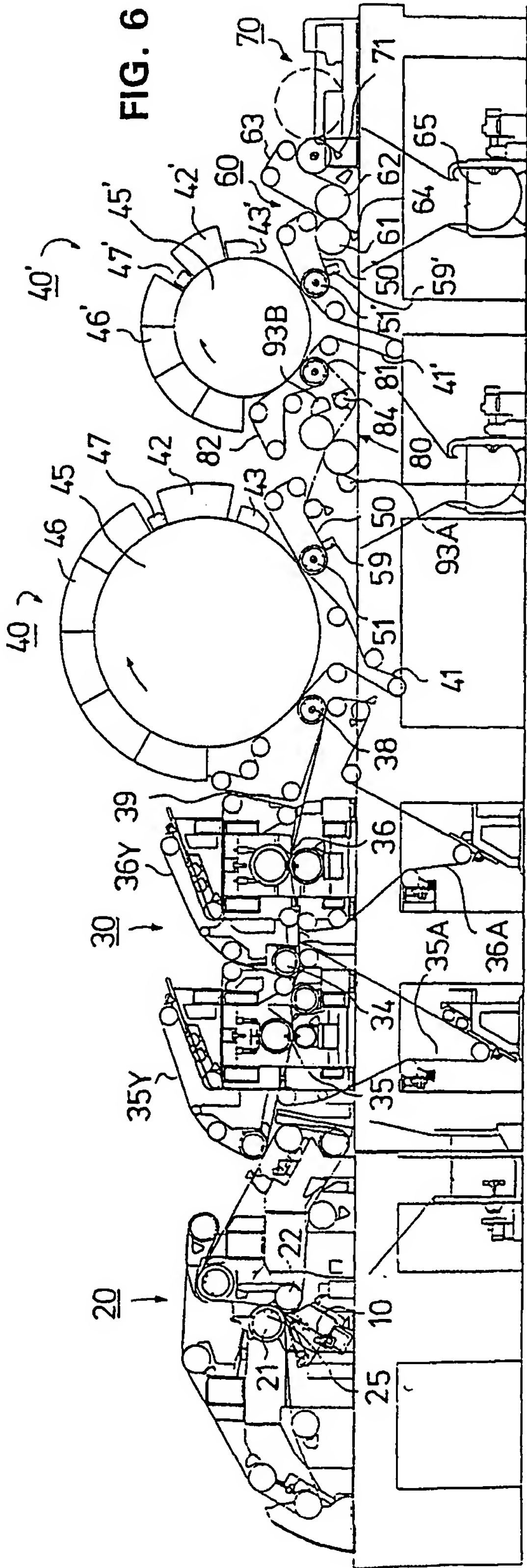


FIG. 8

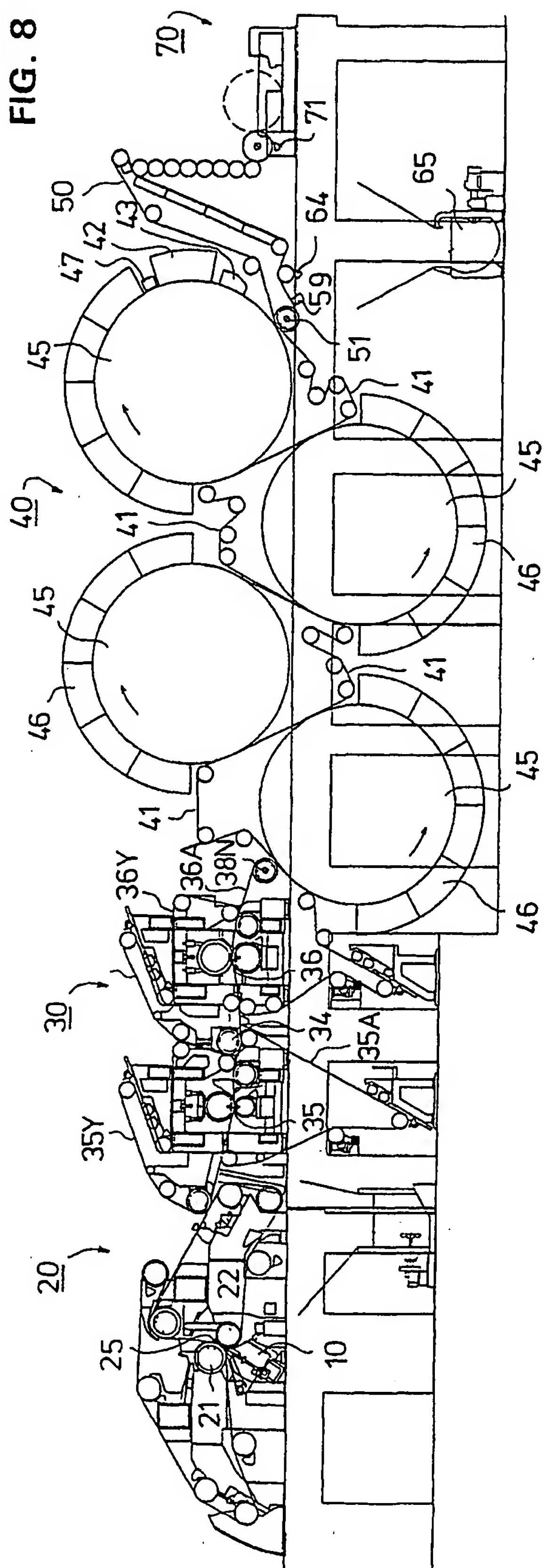
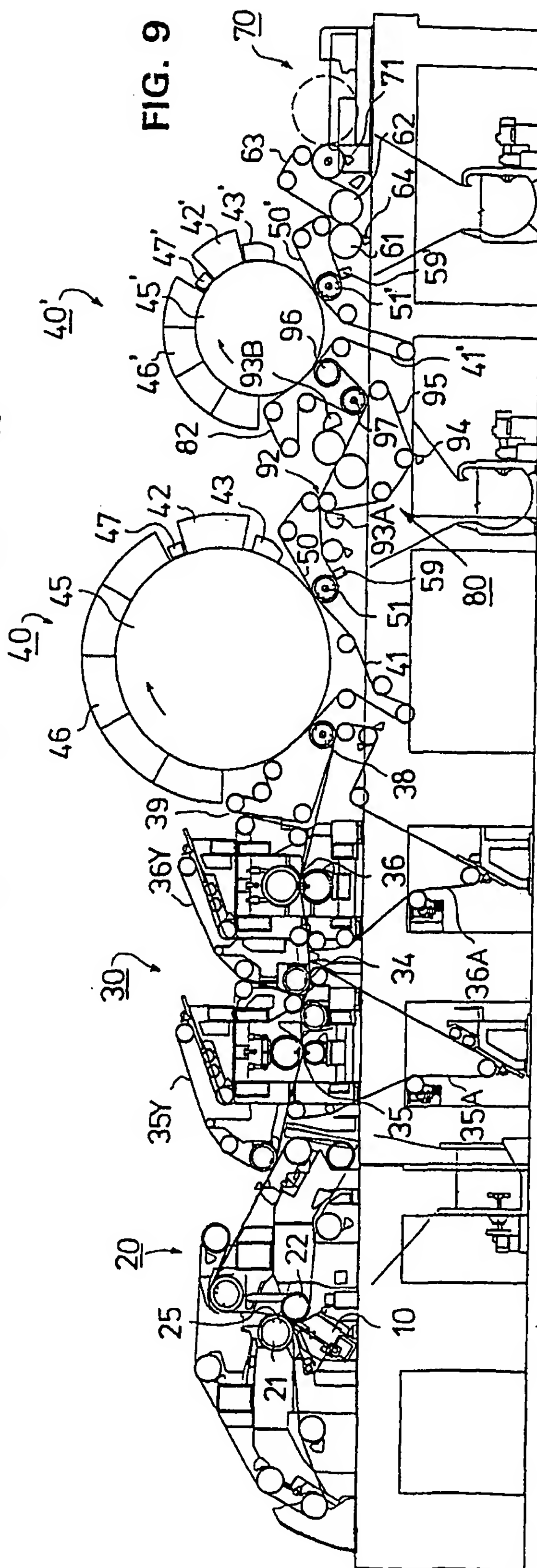


FIG. 9



INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 01/01040

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: D21F 9/00, D21F 7/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: D21F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI DATA, EPO-INTERNAL

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9964671 A1 (VALMET CORPORATION), 16 December 1999 (16.12.99) -- -----	1-4, 6-12, 14-26

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

27 February 2002

Date of mailing of the international search report

28-02-2002

Name and mailing address of the ISA/

Swedish Patent Office

Box 5055, S-102 42 STOCKHOLM

Facsimile No. +46 8 666 02 86

Authorized officer

Susanna Lindfors/ELY

Telephone No. +46 8 782 25 00

Information on patent family members

PCT/FI 01/01040

28/01/02

Form PCT/ISA/210 (patent family annex) (July 1998)